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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/819,715	03/29/2001	Yutaka Fukuda	1-122	4082

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EXAMINER

KITOV, ZEEV

ART UNIT	PAPER NUMBER
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2836

DATE MAILED: 08/05/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/819,715

Applicant(s)

FUKUDA ET AL.

Examiner

Zeev Kitov

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✓

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 March 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 - 21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 3 - 7 is/are allowed.
- 6) ☒ Claim(s) 1, 2, 8 - 13, 16, 18 - 21 is/are rejected.
- 7) ☒ Claim(s) 14, 15, 17 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 March 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

1. Specification

A substitute specification is required pursuant to 37 CFR 1.125(a) because the current Specification includes too many sentences, which are hard to understand. The following are examples of such sentences:

page 2, lines 1 – 2: “thus accelerating the protection circuit has limits”,

page 4, lines 7 – 12: “However, as for the short circuit current caused by the load short circuit or the arm short circuit described above, the condenser 105 for the removal of the noises prevents an instantaneous response and the flow of the short circuit current through the IGBT 101 cannot be prevented”.

There is a plenty of typing errors, such as:

Page 14, line 18: “short time is about to flows u though the IGBT 4, a voltage”.

The Substitute Specification in a good idiomatic English is required.

A substitute specification filed under 37 CFR 1.125(a) must only contain subject matter from the original specification and any previously entered amendment under 37 CFR 1.121. If the substitute specification contains additional subject matter not of record, the substitute specification must be filed under 37 CFR 1.125(b) and must be accompanied by: 1) a statement that the substitute specification contains no new matter; and 2) a marked-up copy showing the amendments to be made via the substitute specification relative to the specification at the time the substitute specification is filed.

2. Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

Claims 1, 2 and 8 – 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. A reason for that is a following Claim 1 statement:

“protection circuit for decreasing the main current at a first slope and then reducing the main current at a second slope steeper than said first slope, when said main current becomes a first overcurrent that exceeds a predetermined current value for a first period of time equal to or longer than a predetermined period of time;
and an overcurrent limiting circuit for instantaneously dropping the voltage applied to said gate terminal when said main current becomes a second overcurrent larger than said first overcurrent within a second period of time shorter than said predetermined period of time” (emphasis added).

The conditions set by the claim for instantaneous dropping the voltage applied to the gate terminal is that “a second overcurrent larger than said first overcurrent”, while the first overcurrent is defined only as: “a first overcurrent that exceeds a predetermined current value”. The first overcurrent is not a predetermined entity, but has a dynamically changing value. Therefore, setting condition that “a second overcurrent larger than said first overcurrent” requires comparison of two values of the same main current existing at

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different times. They cannot be compared without use of some special kind of memory.

None of the circuits presented in the application can perform such a task. The Specification is silent about such feature. Since conditions set by the definition of the second overcurrent cannot be satisfied with a help of equipment disclosed in Specification or shown in the drawings, the Claim 1 is rendered as indefinite.

For purpose of examination the second condition was interpreted as follows:

“when said main current becomes a second overcurrent, which exceeds a second predetermined value”.

Claims 12 and 13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. A reason for that is that the Claim 12 uses reference to the Drawings ({100}) as its only limitation. (i) Any reference to the Drawings elements must be enclosed in parenthesis. (ii) Since the reference to the Drawing is the only claim limitation in Claim 12, it makes the claim meaningless (indefinite) and examination of the claim impossible. As to Claim 13, a following statement was not given patentable weight: “wherein one of the said plane direction is {110}”.

3. Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 18 - 21 are rejected under 35 U.S.C. 102(b) as being anticipated by Fukunaga et al. (US 5,375,029).

Regarding Claim 18, Fukunaga et al. disclose all the elements of the claim including a semiconductor element driving circuit having following elements:
a semiconductor switching element (element 1 in Fig.5) having a gate terminal, a first terminal and a second terminal carrying a main current between the first and second terminals (elements E and C in Fig. 5) by applying a control voltage to the gate terminal (element G in Fig. 5), the semiconductor element outputting a detection current substantially proportional to the main current from a detection terminal (through terminal S in Fig. 5) and an overcurrent limiting circuit (inside dashed area in Fig. 5) for adjusting the control voltage applied to the gate terminal so that said main current becomes equal to or under a predetermined current value; the overcurrent limiting circuit includes a current detection resistance connected to a detection terminal for converting said detection current outputted from the detection terminal into a detection voltage (elements RS1 and RS2 in Fig. 5) and a detection resistance switching unit (element 9 in Fig. 5) for decreasing a resistance value of said current detection resistance until said gate voltage applied to the gate terminal is under a reference voltage which is lower than a full-on voltage by which said semiconductor switching element becomes a full on state (col. 10, lines 6 – 68, col. 11, lines 1 – 11).

Regarding Claim 19, Fukunaga et al. disclose the detection resistance switching unit including following: a control voltage detecting unit detecting the control voltage (element 3 in Fig. 6), a short-circuiting unit short-circuiting a part of said current

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detection resistance (element 10 in Fig. 6) and a short circuit driving unit (element 5 in Fig. 6) decreasing the resistance value of said current detection resistance by driving said short-circuiting unit during said control voltage detected by said control voltage detecting unit is under the reference voltage (col. 11, lines 33 – 65).

Regarding Claim 20, Fukunaga et al. disclose the current detection resistance comprising a first detection resistance (element RS1 in Fig. 6) connected to a second detection resistance in series (element RS2 in Fig. 6), wherein the short-circuiting unit (elements 5 and 10 in Fig. 6) short-circuits one of said first detection resistance (element RS1 in Fig. 6) and said second detection resistance (col. 11, lines 33 – 65).

Regarding Claim 21, Fukunaga et al. disclose the semiconductor switching element as an IGBT (element 1 in Fig. 5 and 6) having a gate terminal as the control terminal (terminal G in Fig. 5 and 6), a collector terminal as the first terminal (element C in Fig. 5 and 6), and an emitter terminal having a main emitter terminal as said second terminal and a sub emitter terminal as said detection terminal (elements E and S in Fig. 5 and 6).

4. Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

a) Claims 1, 2 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schmidt et al. (US 5,550,702) in a view of Sasagawa et al. (US 5,200,879) and further in a view of Masanek et al. (US 5,831,807).

Regarding Claim 1, Schmidt et al. disclose following elements of the claim including an overcurrent limiting circuit (see Fig. 2) instantaneously dropping the voltage applied to the gate terminal of the transistor (element M1 in Fig. 2) when the main current becomes equal to a second overcurrent value (col. 1, lines 55 - 67). Since there is no any delay element in the feedback loop of the circuit, it provides the fastest possible (instantaneous) dropping a voltage applied to the transistor gate. It further discloses a semiconductor switching element having a gate terminal, a first terminal and a second terminal (element M1 in Fig. 2) carrying a main current between the first and second terminals by applying a voltage to the gate terminal. However, it does not disclose decreasing the main current at a first slope and subsequently at a second slope.

Sasagawa et al. disclose decreasing the main current at a first slope (period t_1 - t_2 in Fig. 3C) and then reducing the main current at a second slope (period t_2 - t_3 in Fig. 3C) steeper than said first slope, when said main current becomes a first overcurrent that exceeds a predetermined current value (equation (2)) for a first period of time equal to or longer than a predetermined period of time (a delay time T_d). This time is larger than the time necessary to switch-off the transistor in the circuit Fig. 2 of Schmidt et al.; therefore, a condition of claim that a second period of time is shorter than the predetermined period of time (T_d) is satisfied.

Both patents have the same problem solving area, namely protecting the switching transistor controlling the inductive load from damaging overvoltage. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified a solution of Schmidt et al. by adding a soft cut off of Sasagawa et al., because of following reasons (a) as Sasagawa et al. state (col. 3, lines 38 - 45), a so-called soft interruption is necessary, to prevent a counter-electromotive force caused by the wire inductance L from destroying the transistor. (b) At the same time, according to Masanek et al. (col. 2, lines 53 – 67, col.3, lines 1 – 16), even 10 microseconds delay times may be too long for protection of IGBT in a case of a short circuit. Therefore, according to him, both overload and fast, short circuit, protections are necessary to ensure reliable IGBT control of the load.

Regarding Claim 2, Schmidt in his prior art discloses a short circuit protection, which as was stated above, should work instantaneously.

Regarding Claim 9, Sasagawa et al. disclose a semiconductor switching element driving circuit as an IGBT having a collector terminal as said first terminal and an emitter terminal as said second terminal (element Q1 in Fig. 2). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the IGBT as a semiconductor switching element in the circuit of Schmidt et al., because, as well known in the art, the IGBT has a high input impedance and therefore can be controlled by a very low power CMOS logic and at the same time has substantial current carrying capability.

b) Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schmidt et al. in a view of Sasagawa et al., Masanek et al. and further in a view of Fukunaga et al. As was stated above, Schmidt et al., Sasagawa et al. and Masanek et al. disclose all the elements of Claim 1. Regarding Claim 8, Schmidt discloses an overcurrent limiting transistor (element Q1 in Fig. 2) having a collector connected to said gate terminal and a base to which a voltage controlled based on said sense current is applied, wherein said overcurrent limiting transistor is turned on to reduce the voltage applied to said gate terminal based on said sense current. However, he does not disclose a sense terminal connected to the semiconductor switching element for carrying a sense current substantially proportional to said main current. Fukunaga et al. disclose a sense terminal connected to the semiconductor switching element for carrying a sense current substantially proportional to said main current (element S in Fig. 5). All the reference patents have the same problem solving area, namely providing overcurrent protection to IGBT. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the Schmidt circuit according to Fukunaga et al., because according to Fukunaga et al. (col. 1, lines 12 – 27), it is common solution in modern technology.

c) Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schmidt et al. in a view of Sasagawa et al., Masanek et al. and further in a view of Tomomatsu et al. (US 5,729,032). As was stated above, Schmidt et al., Sasagawa et al. and Masanek et al. disclose all the elements of Claims 1 and 9. However, regarding Claim 10, they do

not disclose the IGBT, which has elements having different threshold voltages.

Tomomatsu et al. disclose the IGBT, which has a plurality of the elements connected in parallel and having different threshold voltages (see an Abstract). All the reference patents have the same problem solving area, namely providing an overcurrent protection to IGBT. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have modified the Schmidt et al. transistor by the IGBT transistor having plurality of parallel connected elements having different thresholds according to Tomomatsu et al, because according to Tomomatsu et al. (col. 1, lines 34 – 67, col. 2, lines 1 – 27), power IGBT transistors, especially with a sense electrode, are always built as a plurality of parallel connected elements, and according to Tomomatsu et al. (see the Abstract), making the sense IGBT cell with a threshold higher than the main IGBT cell prevents the IGBT protection circuit from false triggering in the turn-on period.

d) Claims 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schmidt et al. in a view of Sasagawa et al., Masanek et al., Tomomatsu et al. and further in a view of Seok (5,753,942). As was stated above, Schmidt et al., Sasagawa et al., and Masanek et al. and Tomomatsu et al. disclose all the elements of Claims 1, 9 and 10. However, regarding Claims 11 and 13, they do not disclose the IGBT, forming channels in different plane directions, nor they disclose a hexagonal shape. Seok disclose the hexagonal structural shape (Fig. 6, col. 5, lines 24 – 27), which implicitly has channels in different plane directions. Moreover, his structures lie in the same

plane. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have further modified the Schmidt et al. transistor by the IGBT transistor according to Seok, because as Seok states (col. 1, lines 38 – 67, col. 2, lines 1 – 45), a circular and eventually, hexagonal structure, has advantage of inhibiting a parasitic thyristor latch-up problem.

e) Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Schmidt et al. in a view of Sasagawa et al. and Masanek et al. and further in a view of Zeller (US 5,550,444). As was stated above, Schmidt et al., Sasagawa et al. and Masanek et al. disclose all the elements of Claim 1. However, regarding Claim 16, they do not disclose a semiconductor switching element driving circuit being utilized in the automobile motor driving circuit for controlling a motor of an electric vehicle or hybrid vehicle. Zeller discloses a semiconductor switching elements (elements 114, 124 and 134 in Fig. 1, col. 6, lines 30 – 36) being used in the automobile motor driving circuit (col. 1, lines 62-67, col.2, lines 1 – 2) for controlling a motor of an electric vehicle. It further discloses the switches being of IGBT-type (col.4, lines 15 –66). All the reference patents have the same problem solving area, namely use of IGBT switches. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to have the modified solution of Schmidt et al. for control of electric motor driving a vehicle, because as Zeller states (col. 1, lines 20 – 67, col. 2, lines 1 – 2), a return of kinetic energy stored in the electric motor, which requires use of IGBT switches, is especially important in the electric motor cars.

5. Allowable Subject Matter

a) Claims 3 –7 are allowed. A reason for that is that the independent Claim 3 includes, inter alia, following limitation: an overcurrent protection circuit for decreasing the main current at a first inclination when the main current becomes larger than a second comparison current that is lower than said first comparison current, and then reducing the main current at a second inclination steeper than the first inclination when the main current becomes smaller than a third comparison current that is lower than said second comparison current. The closest references for the claim are Sasagawa et al. Sasagawa et al. disclose decreasing the main current at a first inclination and then reducing the main current at a second inclination steeper than said first inclination. However, it does not disclose a condition for that change of steepness, namely that the main current becomes smaller than a third comparison current that is lower than the second comparison current. This limitation was not found in the collected prior art of the record.

b) Claims 14, 15 and 17 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. A reason for that is that the claim 14 recites a gate electrode having a striped shape, and forming channels on both sides of the gate electrode, and having different threshold voltages on both sides of the gate electrode. Such limitation was not found in the collected prior art of the record.

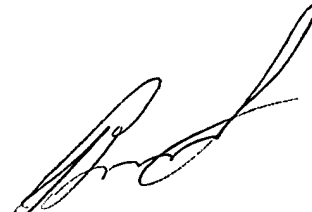
Conclusion

The prior art made of record not relied upon is considered pertinent to applicant's disclosure: US 5,710,508, US 5,485,341, US 5,444,595.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Zeev Kitov whose telephone number is (703) 305-0759. The examiner can normally be reached on 8:00 – 4:30. If attempts to reach examiner by telephone are unsuccessful, the examiner's supervisor, Brian Sircus can be reached on (703) 308-3119. The fax phone numbers for organization where this application or proceedings is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Z.K. 07/03/2003



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